CLASS 10 SCIENCE EXTRA QUESTIONS

Class 10 Science Chapter 11 Electricity Extra Questions (HOTS)

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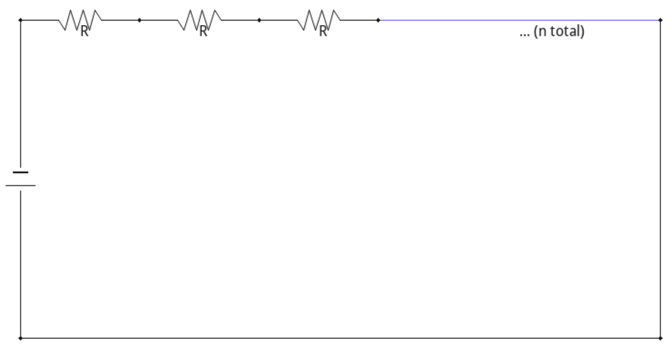
Q1 (General derivation). Derive an expression for the equivalent resistance of n identical resistors, each of resistance R, when connected (a) in series, (b) in parallel. Hence show that R_series / R_parallel = n².



(a) n identical resistors R in series: R_s = nR.

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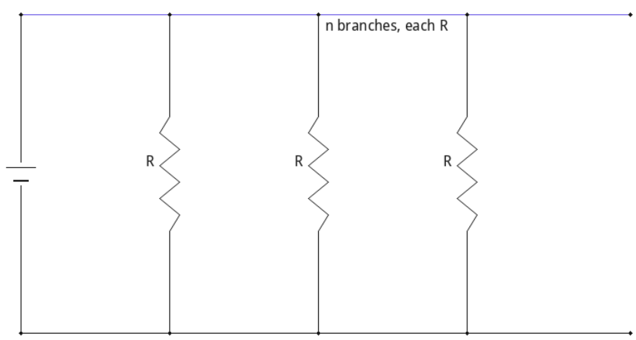

(b) n identical resistors R in parallel: 1/R_p = n/R.
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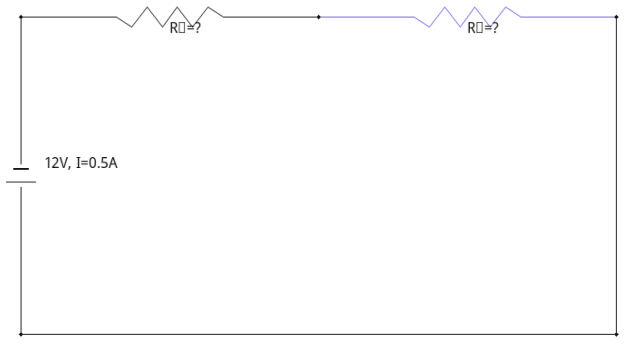
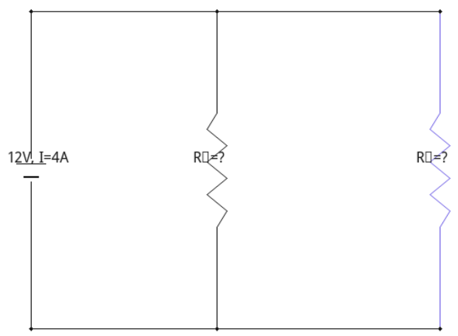
Solution: (a) Series: $R_s = R+R+\ldots$(n times) $= nR$. (b) Parallel: $1/R_p = n/R \Longrightarrow R_p = R/n$. $R_s/R_p = nR \div (R/n) =$ **n^2.** (Proved — this is why series resistance grows much faster than parallel resistance drops as you add more identical resistors.)

Q2 (Reverse-engineering). Two resistors are connected in series to a 12 V battery, drawing a current of 0.5 A. When connected in parallel to the same battery, the current drawn is 4 A. Find the two resistances.



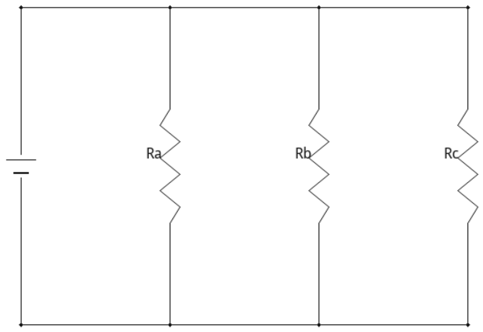
R_1+R_2 in series: 12V, I=0.5A → $R_1+R_2=24\Omega$.



Same R_1,R_2 in parallel: 12V, I=4A → $R_1R_2/(R_1+R_2)=3\Omega$.

Solution: Series: $R_1+R_2 = 12/0.5 = 24\ \Omega$. Parallel: $R_1R_2/(R_1+R_2) = 12/4 = 3 \implies R_1R_2 = 3\times24 = 72$.
R_1, R_2 are roots of $x^2 - 24x + 72 = 0 \implies x = [24 \pm \sqrt{(576-288)}]/2 = [24 \pm \sqrt{288}]/2 = [24 \pm 16.97]/2 \implies x \approx$ **20.48 Ω and 3.51 Ω.**

Q3 (Assertion-Reason). Assertion (A): The equivalent resistance of a parallel combination is always less than the smallest individual resistance in the group.



Parallel combination: R_p is always less than the smallest of Ra, Rb, Rc.

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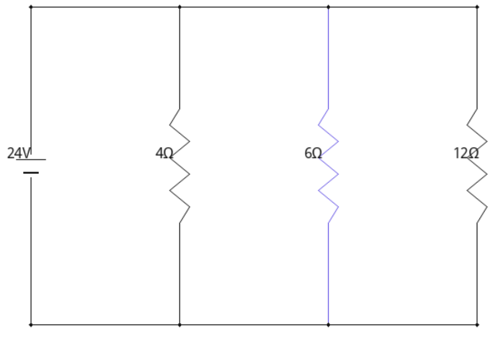
Reason (R): Adding a resistor in parallel always creates an additional path for current, increasing the total current drawn from the source for the same voltage.
Solution: Both A and R are true, and R correctly explains A — more parallel paths mean more total current for the same voltage, which by V=IR means lower equivalent resistance.
Answer: (a) Both A and R are true, and R is the correct explanation of A.

Q4 (Fresh-numbers word problem). An electric iron of resistance 20 Ω draws a current of 5 A. Calculate the electrical energy consumed in 30 minutes, and the cost of using it for 30 days at this rate if electricity costs ₹7 per unit (kWh).
Solution: $P = I^2R = 25\times20 = 500$ W = 0.5 kW. Energy per day = 0.5 kW × 0.5 h = 0.25 kWh. Over 30 days: 0.25×30 = 7.5 kWh. Cost = 7.5×7 = **₹52.50.**

Q5 (Circuit-reasoning, fresh numbers). Three resistors of 4 Ω, 6 Ω and 12 Ω are all connected in parallel to a 24 V battery. Find (a) the equivalent resistance, (b) the total current drawn, (c) the current through the 6 Ω resistor.



4Ω, 6Ω, 12Ω resistors in parallel across a 24V battery.

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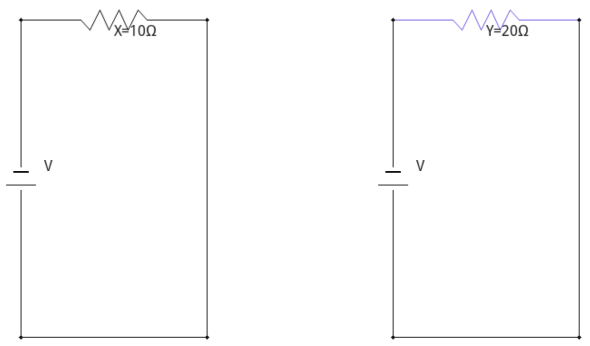
Solution: $1/R_p = 1/4 + 1/6 + 1/12 = 3/12+2/12+1/12 = 6/12 = 1/2 \Longrightarrow R_p =$ **2 Ω.** Total current I = 24/2 = **12 A.** Current through 6 Ω (parallel, full 24 V across it) = 24/6 = **4 A.**

Q6 (Power-heat synthesis). Two heating coils, X (resistance 10 Ω) and Y (resistance 20 Ω), are available. Which coil, used alone across the same voltage supply, will produce heat faster, and by what factor?



Coil X (10Ω) vs coil Y (20Ω) across the same voltage V — X produces heat twice as fast.

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Solution: For the same V, $P = V^2/R$, so power (rate of heat production) is inversely proportional to resistance. Coil X (10 Ω) produces heat at **twice the rate** of coil Y (20 Ω), since $P_X/P_Y = R_Y/R_X = 20/10 = 2$.